SUMMING-UP

1 Animal coverings

- Body coverings play an important role in protection and help to maintain **homeostasis**, which is the ability of living things to maintain constant and controlled conditions in their internal environment.
- In invertebrates, the coating consists of a simple **epithelium**, or a hard **exoskeleton**.
- In vertebrates, the skin is made of two layers of covering: the outer **epidermis** and the inner **dermis**. Below the dermis there is a layer of fat, which is therefore called *subcutaneous fat*.
- The skin of vertebrates is characterised by different structures, **skin appendages**, which can have different forms and functions. Some examples of skin appendages are reptile scales, bird feathers and mammal fur.

2 Control of body temperature

- All animals must maintain their body temperature within a certain range and they do so by following two principal strategies.
- **Ectothermic** animals, also known as "cold blooded", can only exchange heat with the external environment.
- **Endothermic** animals, or "warm blooded", in addition to exchanging heat with the environment, are also able to produce heat through their own metabolism.
- There are many adaptations in animals to both retain heat and to dispose of it. In addition, to aid thermoregulation, some animals adopt particular behaviour or adjustments to metabolism.

3 The control of water loss and salt concentrations

- Animals that have to live in an environment that has a salt concentration equal to, or similar to, that of their internal environment would otherwise lose or gain water by osmosis.
- In some marine organisms, called **isosmotic organisms**, this occurs as the internal liquids in their bodies have the same salt concentration as seawater.
- The greater proportion of animals are instead forced to expend energy to counteract the loss or acquisition of water by osmosis.
- These are **osmoregulatory organisms**, among which three cases are distinguishable:
  - freshwater animals which oppose the continuous entry of water by osmosis, producing hypotonic urine with very low ion content;
  - seawater animals counteract water loss by drinking large amounts of water and eliminating the solutes through the urine and gills;
  - terrestrial animals tend to lose water through transpiration, and must constantly take water in through food or drinking.

4 Animals eliminate waste substances

- Animals must eliminate certain harmful substances resulting from the metabolism of proteins and nucleic acids. This process is called **excretion** and occurs in three main ways.
- Aquatic animals, like fish and invertebrates, eliminate **ammonia** by expelling it from the gills or from the surface of the body.
- Mammals, amphibians and sharks convert ammonia into **urea**, a less toxic substance that can be stored and expelled through the urine.
- Birds and reptiles produce **uric acid**, a solid and insoluble compound, which is excreted in the faeces.

5 The human excretory system

- The human excretory system filters the blood, cleaning it of residues from the metabolism of proteins and harmful substances, or those that are no longer needed.
- The excretory organs are the **kidneys**, which are formed by a large number of functional units called **nephrons**.
- Nephrons are composed of small tubes in which some sections are known to serve different functions: *Bowman's capsule* and the *glomerulus* of capillaries filter the blood, obtaining a filtrate containing a large percentage of water, ions, sugars and other useful substances; the *proximal convoluted tubule* is the section of the nephron that leads towards the innermost part of the kidney, in which some of the filtered solutes are reabsorbed; the *loop of Henle* is the section that folds and turns back towards the outer region of the kidney, where most of the filtered water is reabsorbed.
- The end product of renal filtration is **urine**, an aqueous solution containing urea and other solutes. It is excreted out through the collecting duct, ureters and urinary tract.

SUMMING-UP

6 Maintenance of homeostasis in plants

- In plants, the loss of water by evapotranspiration can become excessive. Plants living in arid environments, called **xerophytes**, and plants that live on saline soils, called **halophytes**, have a set of adaptations to maintain homeostasis.
- Some adaptations are related to the shape of the leaves and roots, while others relate to the reproductive cycle.
- Succulent plants instead possess a particular mechanism of stomatal opening and closing, called the *Crassulacean acid metabolism* (CAM) (also known as CAM photosynthesis).
- Some species that live on saline soils are able to eliminate the excess salt through the so-called *salt glands*.